AD-A079 696 NAVAL OCEAN RESEARCH AND DEVELOPMENT ACTIVITY NSTL S--ETC F/G 20/1
CRUISE REPORT FOR USNS DESTEIGUER OPERATIONS IN OUTPOST GUMBO.(U)
JUN 79 R S ANDERSON

UNCLASSIFIED NORDA-TN-48 NL

1 of 1
AD
A079696

END
DATE
FILMED
2 80
DDC

5 LEVEL II 14 NORDA Technical Note 48

TN-48

6 # CRUISE REPORT FOR USNS DESTEIGUER OPERATIONS IN OUTPOST GUMBO.


10 Rockne S. Anderson


9 Final rept.,




Ocean Acoustics Division

Naval Oceanographic Laboratory


12 30

11 June 1979





DISTRIBUTION STATEMENT A
Approved for public release;
Distribution Unlimited


Naval Ocean Research and Development Activity

NSTL Station, Mississippi 39529


392 773

LB

## ABSTRACT

OUTPOST GUMBO was an underwater acoustic research operation at four sites in the northeastern Pacific conducted in August 1978. Participants included members from the Naval Ocean Research and Development Activity (NORDA), Defence Research Establishment Pacific (DREP), and the Naval Air Development Center (NADC). Platforms used were USNS DESTEIGUER, CFAV ENDEAVOUR, CFAV ST. ANTHONY, and two CFVP-407 ARGUS aircraft. Data were collected for acoustic bottom interaction, signal excess, and ambient noise, as well as environmental geologic and oceanographic data. Arrays were used as receivers: VEKA (NORDA), TSVLA (NADC), and MEVA (DREP).

This report discusses operations, quantity and quality of collected data, and associated problems as related to NORDA's participation on board USNS DESTEIGUER.

## ACKNOWLEDGEMENTS

The spirit of cooperation and purpose was prevalent among the scientific party, the officers, and crew. CAPT Ludtgendorf provided continual support for the scientific endeavors and created an atmosphere of cooperation. The radio officer, Mr. Nolan, provided willing assistance in setting up the communication systems.

The objectives of OUTPOST GUMBO were ambitious; the scientific party was at maximum capacity, and there was a heavy complement of scientific equipment which filled much of the normally free space. Even the weather was good. The only detracting factor on the operation was the 20° rolls with 7 sec periods on DESTEIGUER which resulted from a ship ballasting modification. Despite the partial failure of VEKA II-22, the amount of data collected was gratifying. Each member of the scientific personnel made a significant contribution to objectives of OUTPOST GUMBO. In addition to members of the on-board party, Dr. Samuel Marshall, Division Head of NORDA Code 340, took an active part in the planning of OUTPOST GUMBO. In particular, he invited the participation of NADC and encouraged the broad scope of OUTPOST GUMBO.

The efforts of the three organizations applied to three major cooperative projects enhanced the entire operation. The time and resources were utilized efficiently, and the combined expertise and equipment resources strengthened the operations.

Especially worthy of appreciation are the cordial and competent members of the MSC office in Seattle for their invaluable assistance.

CONTENTS

## ILLUSTRATIONS



## TABLES

## I. INTRODUCTION

OUTPOST GUMBO was a multi-agency, multi-purpose operation to conduct acoustic experiments. This operation was initially conceived as a two-ship operation for a joint effort between the Naval Ocean Research and Development Activity (NORDA) and the Defence Research Establishment Pacific (DREP) to conduct a joint bottom interaction experiment. In addition to the bottom interaction experiments, the operation expanded to include the Naval Air Development Center (NADC), three ships and aircraft, and encompassed measurements of ambient noise, signal excess and directionality. Key equipment used for receiving signals were arrays: VEKA IA and VEKA II-22 on USNS DESTIEGUER, MEVA (DREP), and TSVLA (NADC) on CFAV ENDEAVOUR. CFAV ST. ANTHONY towed an MRA-119 projector for signal excess, and dropped SUS charges for bottom interaction experiments. Plans and equipment are described in references (1) and (2). Reference (3), as amended by reference (4), assigned R. S. Anderson the responsibilities of Senior NORDA Scientist for OUTPOST GUMBO. DESTEIGUER's participation in this cruise was also identified by the Naval Oceanographic Office (NAVOCEANO) as the second leg of DESTEIGUER Cruise 1208-78.

In cooperation with the OUTPOST GUMBO operation, NORDA Code 360 (Sea Floor Division) conducted a cruise in July 1978 (the first leg of DESTEIGUER Cruise 1208-78) on DESTEIGUER immediately before OUTPOST GUMBO. Surveys and cores were taken in the vicinity of Stations C, A, and T during this effort to complement the data acquired in OUTPOST GUMBO for bottom interaction studies.

## II. ITINERARY

USNS DESTEIGUER arrived in Seattle from the previous cruise at 1600 Monday, 31 July 1978, one day ahead of schedule. Equipment arrived from Bay St. Louis, Mississippi, on Friday, 4 August. A presail conference at DREP involving NORDA personnel was also held that day. DESTEIGEUR sailed as scheduled on Tuesday, 8 August, for the OUTPOST GUMBO operation along the track shown in Figure 1. Operations were in cooperation with Canadian ships ENDEAVOUR and ST. ANTHONY, and ARGUS aircraft from CFVP-407. DESTEIGUER returned to port on Monday, 28 August, one day ahead of schedule. Equipment was transferred to trucks for shipment on Tuesday and Wednesday. All personnel were relieved of duty by Wednesday evening, 30 August 1978.

## III. STATION LOCATIONS

The stations were chosen predominantly based on environmental criteria relevant to the bottom interaction experiments as discussed in reference (2). The topography at Stations C and T is smooth, with turbidite sediments containing many reflective sand layers. At C, the basaltic basement is rough and apparent on the sparker records; at T, the basement is deeper and less apparent. C is the only station in a bottom-limited area. Station T was located far enough west to provide a long distance with deep water in the direction of C for the long range propagation run by aircraft between the two sites.

Station A was chosen because of the rough topography without the excessive relief found in a spreading zone or on a seamount. The failure of the navigation systems made it difficult to locate the two orthogonal bottom interactive runs precisely, therefore, the northward run was over smoother topography than desired. The boundary of the abyssal hill zone shown in the base map of Figure 1 should be extended to pass through the Station A Site.

Station S was the result of a late decision based on modifications to the VEKA II-22 deep deployment. This station provided a shallow bottom adjacent to deep water in a logistically desirable location.

The locations of Stations C, A, and T shown in Figure 1 are those listed in reference (1). The actual location as defined by the position of DESTEIGUER during the bottom interaction experiments are listed in Table 1. The exact position and water depth is at the time (in both local and GMT) listed in the table. Station S is at the location of the ship during the projector tow.

## IV. PERSONNEL

DESTEIGUER carried the maximum number in the scientific party. These personnel were primarily from NORDA Code 340 (Ocean Acoustics Division) and Code 350 (Ocean Technology Division):

| | |
|---|---|
| John Alderette | NAVOCEANO Coordinator |
| Rockne S. Anderson | NORDA Code 344, Senior NORDA Scientist |
| Gerald B. Morris | NORDA Code 345 (Array Effects Branch) |
| Jon Berkson | NORDA Code 344 (Boundary Effects Branch) |
| Robert Field | NORDA Code 344 |
| William Cronin | NORDA Code 341 (Assist Code 344) |
| Dan Ramsdale | NORDA Code 345 |
| Roger Howerton | NORDA Code 345 |
| Richard Swenson | NORDA Code 350 (Ocean Technology Division) |
| Al Sutherland | NORDA Code 350 |
| Robert Rumpf | NORDA Code 350 |
| Donith J. Johnson | NORDA Code 350 |
| Allen Albrecht | NORDA Code 350 |
| Paul A. Peloquin | Sanders, Inc. |
| John Moore | Offshore Navigation, Inc. |
| Ross Chapman | DREP |

Ambient noise and signal excess experiments required that personnel operate the computer continuously for data acquisition or analysis. Four persons were assigned this responsibility.

During bottom interaction experiments, five people were required to monitor the recorder, monitor and set amplifier gains, operate the computer, log events, and monitor navigation equipment.

One person was required to be in the lab at all times to annotate depth recording equipment, keep the event log, and communicate with the bridge as needed. Four people were assigned to handle the 4-hour shifts continuously.

The operation of VEKA required a crew to deploy and recover the array, to monitor the electronics equipment and to work out any problems. The six persons from NORDA Code 350 and Sanders, Inc., were assigned this responsibility.

The NAVOCEANO coordinator took the SVSTDs and XBTs, operated the sparker equipment, obtained SATNAV fixes, and assisted as needed with electronic capability.

## V. ACCOMPLISHMENTS

A summary of the OUTPOST GUMBO experiments on DESTEIGUER is given in Table 2 and described below.

### A. BOTTOM INTERACTION

The objective was to measure impulsive signals reflected from the bottom in areas of different bottom types. SUS charges were detonated at different depths and along two orthogonal tracks out to the first convergence zone at Stations C, A, and T. Signals were received by VEKA 1A on DESTEIGUER and MEVA on ENDEAVOUR from shots dropped from ST. ANTHONY. The geometry of the bottom interaction experiment is shown in Figure 2. The 244 m depth SUS were dropped at close spacing (nominal 1/2 nm) to provide a dense spacing for reflectivity analyses along two orthogonal runs, shown in Figure 3. On one run, deeper charges (610 m) were dropped at twice this spacing (nominal 1 nm) to provide a different size of insonified area of the bottom, but at the same grazing angle. To further exploit this capability, five SUS detonated at 1220 m were dropped during the same run over a predetermined region. This region corresponds to the region of predicted maximum change in the bottom loss curves expected for this area. Other runs used 18 m and 183 m SUS for DREP. Tracks of ST. ANTHONY during the experiment are shown in Figure 3; the runs are labeled SB11 through SB34. Tracks are determined by trisponder and radar fixes on board DESTEIGUER only. Bearings will be modified later with navigation data from DREP.

Although data reduction has not been possible to date, the results are anticipated to be satisfactory. The direct and bottom reflected signals from SUS detonated at varying ranges were recorded via VEKA 1A, with signals from 10 elements passing through variable gain Ithaco amplifiers and an additional signal on a fixed gain HP amplifier onto 11 of the 14 tracks of the AMPEX PR 2200 recorder. Time code and the shot break transmitted by radio from ST. ANTHONY were also recorded. Signals were recorded FM at 3-3/4 ips with a nominal 48 dB dynamic range. During the recording, 2 elements were monitored on a memoscope, with a different set of two being monitored for the next shot, and so forth. From these observations the gains were adjusted as needed. Evaluation will determine whether the signals were recorded with the proper gain setting to permit accurate unclipped recording of the direct with sufficient gain on the reflected signal to permit detailed analysis. Despite this problem, which was greatly exasperated in the high bottom loss area of Station A, the great quantity and redundancy of data assure that there will be much usable data. Data were also recorded digitally using the MTACQ program (see Section V. F). The shot data acquired are listed in Table 3.

### B. SIGNAL EXCESS

Measurements were obtained at Stations S and T using the ST. ANTHONY towing the MRA-119 projector and VEKA II-22 as receiver. Measurements were obtained with TSVLA on ENDEAVOUR for comparison purposes. The tracks of ST. ANTHONY during the projector tows, based on trisponder and DESTEIGUER radar fixes only, are shown in Figure 3. The MRA-119 projected 5 lines simultaneously in the 40-300 Hz range. Exact levels and frequencies are classified.

1. Station S

The projector was towed radially to 33 nm at 300 ft depth and returned on a 5 nmi offset at 60 ft depth. VEKA II-22 was deployed near the bottom at 2200 m (probably touching the sea floor). Data were recorded on 15 digital tapes (1 hour each) and 5 analog multiplexed recordings (3-1/2 hours each). Analog data were verified by play back through a demultiplexer on board. In addition, a single hydrophone spectrum was taken every 15 to 30 minutes during the run to establish regions of strong signal. No source lines at 60 ft depth at any range were observed on the spectrum analyzer. Beamformed data show strong arrivals out to 25 km (14 nm) for the 300 ft depth tow.

2. Station T

The projector was towed radially at a 60 ft depth to 30 nm on course 140°, an arc for 5 nm at 60 ft, then a return run on a 5 nm offset at 300 ft depth. An additional radial tow was at a 300 ft depth to 30 nm on course 090°. VEKA II-22 was deployed to 2000 m. Nineteen digital tapes and 7 analog tapes were recorded. Beamformed results show a great deal of common mode noise which may seriously degrade the data.

C. AMBIENT NOISE

Measurements were made with both VEKA IA and II-22, as well as MEVA and TSVLA. These measurements were made adjacent to the other experiments requiring deployment of the respective array. Plans called for collecting ambient noise data using VEKA II-22 at Stations S and T.

1. Station S

Because of the late arrival at S, it was possible to test only VEKA IA at this station; however, 10 digital tapes (one hour each) of VEKA II-22 noise data were acquired. In addition, analog recordings of the multiplexed VEKA II-22 outputs were also taken.

2. Station C

Tests revealed that many of the channels on the VEKA IA were bad and that the noise samples were very erratic. No ambient noise data were taken at this station for later beamforming because of the poor performance. Later diagnosis revealed that the problems were in the electrical junction between the array cable and the umbilical cable.

3. Station A

Following the deployment of VEKA IA for the bottom interaction work, a variety of tests and samples were made to determine if the array was working better than at the previous station. It was. Prior to the bottom interaction SUS run, five digital tapes of noise data were recorded covering approximately 5-1/2 hours. The first three contained a high percentage of overloads as a ship passed within 5.8 nm of USNS DESTEIGUER. At this time there were four bad hydrophones out of a total of 29. After the SUS run, an additional five digital tapes of noise were taken again, covering a time interval of about 5-1/2 hours. These data contain few overloads. In all, 10 digital tapes of noise were acquired at this site where no previous plans had been made to take such data.

4. Station T.

After using the VEKA IA for the bottom interaction studies, eight digital tapes of noise were taken over a 9-1/2 hour interval.

Analysis of the data reveals that the noise radiated from the DESTEIGUER, particularly during maneuvering, often dominates the received noise. At Station A the wind was low so that only periodic maneuvering of the ship was necessary. Thus, the platform-radiated noise was only a moderate problem. The beamformed results show that the ambient noise from about 20 Hz to 150 Hz is concentrated in angles within $\pm$ 15° of the horizontal. Because of the dead elements in the array, sidelobe suppressions of only about 15 dB are possible. At Station T the wind and sea state was higher and necessitated almost constant use of the active rudder to hold station, so that noise radiated by DESTEIGUER was high. This coupled with the fact that another hydrophone did not work gave rise to poorer sidelobe suppression.

D. CORES

Bottom samples were obtained at each site where bottom interaction experiments were conducted. NORDA Code 360 had obtained samples at Stations C and T on the previous cruise. Sound velocity measurements were made on board with an Underwater Systems velocimeter.

1. Station C

Code 360 attempted four cores in the vicinity, the longest sample was seven feet. Characteristic of the cores is a thin (10 cm), watery, chocolate-brown mud layer overlying a firm gray clay containing layers of dark sand. The sand layers prohibited much penetration. Because of the previous attempts and expectation of difficulty in obtaining a long sample, a core was not attempted at Station C and the time was used for other purposes.

2. Station A

After their last core was taken, Code 360 reset the Big Charlie corer with a 10 ft barrel. This setup was used at Station A. At this site, the profiler records show good indication of areas of ponded sediments. The expected sediment in the abyssal hills area is lutite, and eight feet of gray lutite was recovered. However, surprisingly high sound speed was measured between 50 and 80 cm depth, peaking to 1630 m/sec with no visible indication. The rest of the core had the expected low sound speed of 1485 m/sec, or 3% less than that of the sea water.

3. Station T

A 10 ft core was attempted while the ship was rolling moderately. The tensiometer was continuously monitored and excursions to zero tension, which would indicate a pretrip, were not observed. However, no mud was recovered in the cutter and the breakaway piston had not separated. The only sample was that scraped from the outside of the core liner after it had been removed from the pipe. It was predominantly coarse sand. Either the sand layer was the top layer, or else the overlying mud sample had been washed away. Code 360 had recovered five feet of very sandy mud with a 40 ft core barrel. On a second attempt with a 20 ft barrel, they obtained 18 inches of mud on top of sand and bent the barrel.

E. SURVEY

NAVOCEANO equipment was used for survey: the 30 kilojoule sparker recorded in a band of 32-98 Hz and the 3.5 kHz system. The sparker was not used at Station S, but was used at all surveys thereafter.

1. Station S

A bathymetric survey was conducted to verify the detailed charts and navigation available. The objective was to find an area of about 2250 m depth in order to deploy VEKA II-22 within 100-200 m of the sea floor.

2. Station C

A minimal survey with the sparker was conducted to cover the S . ANTHONY tracks during the bottom interaction run. On the previous cruise de 360 had acquired several crossings of this area with the sparker.

3. Station A

The survey provides some north-south tracks, and when combined with surveys conducted on USNS SURVEYOR (available from NOAA), provides a dense set of east-west tracks at about 3 nm separation. ST. ANTHONY dropped SUS for the bottom interaction experiment along or very close to the survey tracks. This area, unlike the other stations, has rough topography. The northward track of ST. ANTHONY for the experiment was surveyed at the end of Station A operations.

4. Station T

A survey similar to that at C was conducted, plus a 90 minute sparker run enroute to T for the benefit of DREP. Code 360 had surveyed this area extensively on the previous cruise.

F. SVSTD AND SXBT

Most of the desired XBTs were taken by ST. ANTHONY during runs with SUS or the projector. SVSTDs were taken at three stations to provide accurate sound speed profiles. Only two XBTs were taken aboard the USNS DESTEIGUER.

VI. NARRATIVE

A. PRESAIL CONFERENCE AT DREP ON 4 AUGUST 1978

Attendees at the conference were: NORDA: Rockne Anderson, Gerald Morris, Dan Ramsdale, Rick Swenson, and Sam Marshall; DREP: Jon Thorleifson, Ross Chapman, Glen Turner, Ken Foster, Gordon Ebbeson, John Smith, CAPT Bowles of ENDEAVOUR, and CAPT Dyer and Mr. Reid of ST. ANTHONY; and NADC: Bruce Steinberg.

After brief introductions, a short overview of the project was presented by Rockne Anderson. Details of the precise plans for the projector tows and the SUS drops were discussed and handouts with specifications for these operations were distributed. Station S had been added to the schedule on the previous Monday and details were presented. The need for coincident TSVLA and VEKA II-22 measurements at S was discussed. A working communications code for HF was established for sensitive operations. Other topics included ship maneuvering capabilities, use of SXBTs, time zones, sonobuoys, quiet ship capabilities and requirements, and optimum deployment of VEKA, MEVA and TSVLA for coincident measurements. The meeting finished at about 1500. NORDA scientists visited ENDEAVOUR briefly prior to departure.

Transportation between Seattle and Esquimalt for NORDA attendees was by Kenmore Air Harbor seaplane, chartered by NORDA Code 340 for the round trip. Arrangements for the flight were made through the Naval Undersea Warfare Engineering Station at Keyport. The main advantages of using this commercial aircraft versus flights out of SEATAC airport were convenience and economy of time. The cost was $225 round trip for 5 people compared to $54 round trip per person at SEATAC. Scheduled departure from the pier on Lake Union in Seattle was at 0815 in order to arrive at the meeting at DREP at 0930. Actually, departure was at 0830 with a stop for mail pickup at Keyport and customs clearance at Victoria Inner Harbor. Stopping for customs at Victoria was not necessary, since the passengers were going only to DREP. The plane flew to the Esquimalt Harbor which is within walking distance of the meeting room. The meeting commenced immediately upon arrival shortly before 1000. To extend the meeting, the departure was delayed from 1330 to 1500 after a call to Kenmore to request the delay. However, because of plane engine problems, the pilot had to make repairs and had waited the entire time at the pier. The return flight had one stop at Keyport to return the undelivered mail. The party disembarked at the pier in Lake Union about 1630.

## B. EQUIPMENT INSTALLATION

### 1. Laboratory Equipment

The five PDP-11 computer racks, plus console, plus a gimble mounted printer filled most of the laboratory space. With five extra equipment racks, the lab was quite crowded. Low overhead beams prevented the computer racks from being shock-mounted. Therefore, they were secured directly to the deck by 3/16in cable straps. A small free area on the central counter space, which was mostly filled with NAVOCEANO depth recorders and spares and the SVSTD computer, was used for mounting two AMPEX tape recorders. The third recorder was mounted on the bulkhead counter behind the instrument racks in a less convenient location. Several feet of counter space remained available for work area. The CB and HF radios took up a small portion of this area. The hydrographic lab area was used mainly for storage of NAVOCEANO and NORDA supplies such as coring items, boxes and tapes.

### 2. Deck Equipment

The TSE winch was welded facing the stern U-frame for deployment and recovery of both VEKAs. If one winch had not been damaged during loading on the truck in Bay St. Louis, the deck space would have been perhaps inadequate and the starboard winch would have been used also for VEKA deployment. As it was, the Big Charlie corer effectively blocked the starboard U-frame for other operations. The core equipment had been mounted for the previous cruise by NORDA Code 360 and left for use on OUTPOST GUMBO.

### 3. Antennas

The VEKA and sonobuoy antenna were mounted on the aftermast platform. The trisponder antenna was mounted on the forward mast platform. The CB antenna was mounted on the plate located on the stack holding the tiedown for the crane. The HF cable was connected to the 35 ft ship's antenna on the port side of the stack with the radio operator's assistance.

C. CRUISE

USNS DESTEIGUER arrived in Seattle from the previous cruise (1208-78A) in the afternoon of Monday, 31 July, one day ahead of schedule. Scientific personnel from 1208-78A moved off by Thursday, 3 August. Equipment for cruise 1208-78B, OUTPOST GUMBO, arrived via vans and was loaded on board on Friday, 4 August. The same vans were used to transfer equipment from the previous cruise back to Bay St. Louis, so offloading of this equipment occurred on the same day. DESTEIGUER departed Seattle at 1020 (Pacific Daylight Time; +7 zone) on Tuesday, 8 August, for OUTPOST GUMBO. Prior to departure, scheduled at 0800, divers removed some heavy nylon line draped over the screw shaft. This was discovered shortly before the planned departure. From Seattle, the vessel sailed across Puget Sound to Manchester for refueling. The refueling had been planned at the end of the previous cruise, but late-afternoon arrival time prevented this. Personnel were permitted to go to Manchester or Bremerton during the afternoon. Departure from the fueling pier was at 2020.

DESTEIGUER arrived at Station S at 1900 on 9 August. Immediately, VEKA IA was deployed shallow for two hours to test the phones using pistol shots as sound sources. The purpose was to verify the sequence of the phones as well as the electrical integrity. Between 2250 and 0630 (10 August) a box-shaped survey was conducted to verify the available bathymetry information and establish an exact location for the propagation experiment. The navigation and existing detailed charts of the area proved extremely accurate. At 0630 an SVSTD was taken. Immediately after breakfast, VEKA II-22 was deployed. Noise measurements began on VEKA II-22 at 1100 while MEVA and TSVLA on ENDEAVOUR were being deployed. ST. ANTHONY arrived at 0700 on 11 August. During the morning ST. ANTHONY technicians hooked up the trisponder antenna and made several close runs to the arrays, and then proceeded to the starting position for the projector tow. The projector run for the signal excess experiment started at 1238. The run continued into the night. During this time DESTEIGUER had to maneuver constantly to keep within sight of VEKA II-22. At 0150 the third mate on watch requested the lab to have somebody come to the bridge. DESTEIGUER had run across the VEKA surface umbilical cable. Rick Swenson was called and he directed maneuvers. By 0210 the cable was free of the ship, but the light buoy could not be seen. This buoy had been damaged by DESTEIGUER. It was found after daylight at 0615. The array was recovered in the morning (12 August) and DESTEIGUER departed for Station C at 1230.

DESTEIGUER arrived at Station C at 0500, 13 August. An SVSTD was taken on station. Deployment of VEKA IA began at 0830. By 1500 the array was in place. ENDEAVOUR had deployed MEVA in the morning. ST. ANTHONY was in position to commence the shot run, but the Ampex tape recorder failed. By 1740 it was repaired and the bottom interaction shot run commenced. After the first 12 shots, the recorder again failed. The MTACQ acquisition program, written earlier for the PDP-11, but without an intermittent recording capability, was quickly loaded to record several sets of four shots per tape (10 minutes maximum time). However, near the end of the run, it was discovered that the computer inputs had been disconnected during the analog recording because they appeared to add high frequency noise to the recordings. Therefore, the entire run beyond the first 12 shots was missed. During the second run, only 60 and 600 ft shots were being dropped for the benefit of DREP. This time was used to repair the recorder and modify the PDP-11 acquisition program to have on/off capability. Thus, for the third and fourth runs on the north-south track, shots were recorded on both analog and digital tapes. This series of runs was performed from 1745 to 0445 on 14 August. The long range aircraft run for DREP scheduled for 1100 was delayed until 1400. This run was recorded from shot 7 on to the end. At the end of the run at 1700, VEKA IA was recovered. Departing the site, the sparker survey was conducted along the bottom interaction experiment tracks and onward toward Station A. The sparker was turned off at 0345, well into the rough topography of the Juan de Fuca Ridge.

DESTEIGUER arrived in the vicinity of Station A at 0800, 16 August. The sparker was turned on at 0730. The track taken during the survey from 0800 to 2300 was carefully monitored and plotted in conjunction with archive data to determine optimum tracks for the bottom interaction experiment. A core site was chosen and the ship moved to this location for a core at 0025 on 17 August. The core filled the 10 ft pipe (set up on the previous cruise). The core was back on board at 0415. The ship moved back to the chosen location for the bottom interaction experiment. VEKA IA was deployed between 0730 and 1115. Noise measurements were taken until ST. ANTHONY approached for the commencement of the bottom interaction runs at 1915. The three runs were completed at 0215 on 18 August. ST. ANTHONY secured at the end of the run while ambient noise was recorded until 0900. The array was recovered between 0900 and 1230. An SVSTD was then taken. A sparker survey to cover the 010° track of the bottom interaction runs commenced at 1615. The sparker was kept on until 2220, well out of the Station A area. From there, DESTEIGUER headed toward Station T.

On the approach to Station T, DESTEIGUER turned on the sparker at 46°N, 140°W, between 1000 and 1130 on 20 August, where DREP had previously conducted a bottom interaction experiment. At the approach to the anticipated southern point of the bottom interaction run for this station, the sparker was turned on again at 1315 and left on until reaching the site at 1615. VEKA IA was deployed at T between 1750 and 2000. The bottom interaction run commenced at 2030 and continued to 0815 on 21 August. Noise was recorded until VEKA was recovered during 1830-2000. The ship lay quiet in the water until 0000 on 22 August, at which time an SVSTD was taken (four hours). VEKA II-22 was deployed between 0800 and 1200. The projector tow by ST. ANTHONY commenced at 1410 and continued until 1220 on 23 August. Swells were heavy in the afternoon, with wind speeds ranging from 27 to 30 kn, and the recovery of VEKA II-22 was delayed until 1700. The array was on deck by 2000. DESTEIGUER moved seven miles to locate at a point along the bottom interaction track for a core. A core was taken in moderate swells, but only sand between the liner and the pipe was recovered. The core operation lasted from 2200 to 0130 on 24 August. DESTEIGUER hove to all night. During most of the day, Code 350 personnel cut and spliced the VEKA II-22 umbilical to try to eliminate electrical problems. However, the efforts did not improve the array, so further tests were aborted. The weather was remarkably calm this day, but the operations were completed as far as meaningful measurements were concerned. Between 1400 and 1430 during ambient noise measurements on ENDEAVOUR, DESTEIGUER went into quiet ship mode for the only time on the cruise, using the gas turbine generator. At 1745 the sparker was deployed and a survey conducted along the entire east-west track of the bottom interaction experiment. The sparker was left on until 2300 (24 August).

Heading homewards watches were continued, and the depth recorder kept running until it ran out of paper on the continental shelf at 1430 on 27 August. During the homeward transit, the scientific party used the time to complete logs, analyze computer data, and pack VEKA gear.

## VII. COMMENTS AND RECOMMENDATIONS

### A. VEKA

Two VEKAs were used for operations in OUTPOST GUMBO. VEKA IA had been used on previous cruises, including the HAYES December 1977 cruise with NORDA Code 340 personnel. The unit had difficulties, but problems were sufficiently solved to maintain its usability throughout the cruise. About 25 out of 29 hydrophones were kept operational at all times. The main problems were broken connectors in the 48 pair conductor, hard-wired to the ship. Most of the electrical integrity problems occurred at the splice between the array and the umbilical cables, presumably while going over the sheave. Other problems were due to leaks in the insulation.

The interelement spacing of VEKA IA is 10 m. The gain and recovery times of the electronics are such that the array can record shot data and low-level bottom-reflected signals adequately. Thus, this array was used for the bottom interaction experiments. Elements were chosen for recording on the analog recorders to provide a distribution along the width of the array and also provide a variety of spacings for coherence studies. In addition, beamforming was performed on ambient noise data. However, missing elements reduced sidelobe suppression to a detrimental degree.

VEKA IA was deployed with the TSE winch and stored on the reel. Problems with the use of the array were related to it being tethered to the ship. Vertical motion occurs with the ship moving relative to the array, thus creating geometry variation and noise in the elements. In addition, in order to avoid excessive tension on the line, the ship must be manuevered quite often, which adds unwanted noise.

VEKA II-22 hydrophone array was constructed at Sanders, Inc., and shipped directly to Seattle. The RF buoy was made and mechanical rigging was performed at Pier 91, Seattle. The hydrophones are in a Kevlar jacket with extra connecting cable, permitting them to be positioned as desired. The system employs a distributed frequency division multiplexer. Therefore, only a thin, two-conductor cable is required between hydrophones. The array is suspended from a surface buoy. The intention for OUTPOST GUMBO was to suspend the array near the ocean bottom. However, cable faults were discovered at Bay St. Louis just two weeks prior to the cruise; an alternate umbilical cable was used which provided only 2000 m depth capability. Therefore, the Station C plans for VEKA II experiments were aborted and substituted with experiments at Station S, which was about this depth. Upon recovering the array at Station S, mud was found on the bottom weight, suggesting that the lower part of the VEKA II-22 unit actually touched bottom. After the experiment, the reason came to light. A faulty method of using the cable counter had been used; the cable length was found to be about 200 m longer than measured the first time (before deployment).

VEKA II-22, when deployed, is untethered to the ship, with data being transmitted by radio. The ship must remain sufficiently close to maintain radio contact, yet far enough away to avoid entanglement. As discussed in Section VI. C, DESTEIGUER did entangle with VEKA II-22.

The array responded properly at Station S, except for the excess noise observed in the upper two hydrophones. However, when deployed at Station T, severe dropouts occurred which could not be corrected or diagnosed. Because of the deteriorated quality of the signals some of the planned operations with the array were aborted.

## B. AMPEX RECORDERS

Codes 340 and 350 brought two wide-band and one intermediate-band Ampex PR 2200 recorders. Two of these recorders were used on the HAYES trip in December 1977, and did not work well; once again, the recorders were unreliable. The problems with the recorders can be classified as serious and inconvenient:

### 1. Serious Problems

#### a. Overheating

This was a problem in December on the HAYES cruise. Ampex had modified the recorders by sealing off airleaks with foam, rerouting airflow, and increasing the size of the fan. In one case, however, some foam material used in the modification touched the fan rotor and slowed it down. An air conditioning blower vent tube was taped directly to vent holes on the side of the recorder, which adequately cooled the recorder. Later the problem was diagnosed and remedied.

#### b. Connectors

A few failures occurred because of poor (intermittent) contacts at the connectors. The evidence shows that the type of conductor used, miniature "quick connect," is not suitable for the vibration and the fumes in the air encountered in the shipboard environment.

#### c. Component Failure

The LED in the end-of-tape sensor burned out and caused a recorder failure. Also, indicator lights burned out. These components normally have a very long life. These failures may have resulted from power line fluctuations or spikes. Switching to the regulated 110v power line eliminated further problems. However, other component failures cannot be connected to power line surges as easily. The turn-on power transformer failed. Three transistors on the head preamp card burned out in one recorder. The bias supply failed (as it had also in December). The servo-control card also failed.

All three machines failed at times. By interchanging parts and utilizing spares, two were maintained throughout the cruise. Worthy of note is that the bias supply card was not backed up by a spare. These failures were serious in that they occurred during experiments and resulted in loss of data. The first bottom interaction run was lost and not recovered because of a failure in the recorder.

### 2. Inconvenient Problems

#### a. Door Latches

Ever since Ampex modified the recorders, the doors cannot be latched. Thus, they must be taped shut. This problem is very inconvenient on a rolling platform.

b. Track Signal Switches

During operations, two recording tracks were used simultaneously. Thus, the tape was passed seven times, each time requiring a switching of the inputs (signal and time code) to a different set of tracks. To accomplish this, the door had to be opened and two boards pulled part of the way out in order to set the micro-switches to turn on the appropriate tracks (parallel leads were used on the input plugs). This constant manipulation of the boards resulted in breaking wires. A more satifactory method to switch tracks on and off is necessary for this type of operation.

C. SVSTD

Three SVSTDs were taken with good results. Immediately before the first deployment, the electrical power switch handle for the winch was loose and delayed deployment for an hour until it was tightened. During the first run only, the computer system failed, but recordings were obtained on the strip chart recorder.

D. SXBT

There was little requirement for underway BTs, since ST. ANTHONY took them as needed during the SUS runs and the projector tows. Three T-5s (1830 m) were taken on DESTEIGUER, but the NAVOCEANO requirement not to take them on station because of entanglement with the screws discouraged taking others.

E. NAVIGATION EQUIPMENT

Three navigation systems were available to determine absolute location of DESTEIGUER: LORAN A, LORAN C, and SatNav. Relative navigation between the three ships was accurately measured with a trisponder.

1. <u>LORAN C</u>

The reception geometry at all the stations was undesirable for the LORAN C operation. At best, LORAN C had about a three-mile accuracy when compared to SatNav, and had no consistent pattern. At Stations A and T, signals were lost at night. At A, a close grid (3 nm) survey was conducted from 0800 to 2300 on 16 August. In the evening, both of the LORAN C systems failed. John Moore and John Alderette found a bad coupler on one set with a good receiver. The other receiver failed without being diagnosed. By interchanging parts, one system was operational by the morning of 17 August. At this time, the SatNav had also failed and LORAN A signals were weak. Positions for the bottom interaction experiment were established using bathymetry and dead reckoning. A comparison of LORAN C with the SatNav on ENDEAVOUR at T again indicated a three-mile error.

2. <u>LORAN A</u>

At Stations S and C, LORAN A and SatNav fixes were very close. However, at the more western locations the signal was weak and LORAN C had to be relied on. Also, because LORAN A is not as automated as LORAN C, fixes were only taken when specifically requested.

3. SatNav

Prior to OUTPOST GUMBO, the memory in the primary SRN-9 satellite navigation system failed. The memory from the spare system was used and another one ordered. Thus, leaving port, only the primary system was working. At Station A (16 August) this memory also failed. Thus, no other SatNav fixes on board DESTEIGUER were possible for the balance of the cruise.

4. Trisponder

This unit, borrowed from DREP, measured time-distance between DESTEIGUER (master) and ST. ANTHONY and ENDEAVOUR (slaves). Grounding problems caused rapid spurious printouts a few times when it was not being monitored. During bottom interaction runs, the automatic printout was set for one minute intervals. The unit worked beautifully, exceeding line of sight (30 km) on several runs, with maximum consistent recordings out to 52 km.

Because of the failure of the SatNav aboard DESTEIGUER, navigation reconstruction will be considerably more difficult and time-consuming than anticipated. Future operations requiring accurate navigation control should be equipped with operating SatNav's spared.

F. PDP-11 COMPUTER

The computer, owned by NORDA Code 340, was installed on the HAYES in December, but failed to operate. On OUTPOST GUMBO the computer operated almost continuously without failure, except during the sparker operation (because of possible voltage surges). The machine was used for real-time data acquisition, offline preliminary data analysis, and upgrading of computer programs. The following programs were the main programs used, the first five for the signal excess and ambient noise experiments, and the sixth for bottom interaction.

1. VEKA.OBJ (first-pass)

Acquires 32 channels of data in realtime at 512 (VEKA IA) or 640 (VEKA II-22) samples/second until 1024 samples per channel have been acquired (2.0 sec or 1.6 sec, respectively). Acquisition ceases for about four seconds while the data are processed. An FFT is performed on each channel and 128 of the 512 calculated lines are written onto magnetic tape.

2. BMON28 (second-pass)

Beamforms on the 32 channel FFT lines from first-pass with a selectable number of averages of 2 or 1.6 second data sets (32 or 64 sets were used). The program is operated interactive, allowing tailoring the beamforming to the situation at hand. The name implies the final version of the program after much modification on board.

3. FSORT2 (second-pass)

Provides single hydrophone statistics from the first-pass output by computing the average power of each hydrophone in selectable frequencies and number of averages. This program was considerably modified on board.

4. MUXAPS

Acquires realtime data in 1024 point sets for six channels and plots auto spectra on the screen. This program is essentially a computer spectral analyzer with selectable averages.

5. BEAM2

Calculates beam patterns for a theoretical array to compare with observed results.

6. MTACQ

Acquires 32 channels of data continuously at a rate of 512 samples/second. This program is a modification of VEKA.OBJ, used for the first time during the bottom interaction run when the tape recorder failed at Station C, and was subsequently used to provide digital recordings for the runs. The program was untested and the results have not yet been evaluated.

G. COMMUNICATIONS

The basic communication system between the three ships was the SSB HF system provided by NADC. The DESTEIGUER antenna was tuned for near 7 kHz. However, the other ships had to switch to near 4 kHz to obtain adequate transmission, thus lowering the sensitivity on DESTEIGUER, but not sufficiently to hamper the operation. NORDA Code 340 had purchased two CB base units. These could transmit well to walkie-talkies on ENDEAVOUR, but their power was too limited to transmit back. The transmit mode in one CB unit failed at Station S (the unit was returned under warranty in Seattle). Several times the only way contact could be initiated with ENDEAVOUR was to call them on Channel 16 on the bridge VHF system. Channel 10 had been allocated to OUTPOST GUMBO for communications, but after the initial contact, the conversation was continued on HF. After the first few days, ENDEAVOUR monitored HF, so the VHF method of contact was used infrequently.

H. TIME ZONES

The proper annotation of time on records on DESTEIGUER may lead to confusion. Analog tapes automatically recorded Julian date and GMT time from the time code generator. GMT was used for shot logs, but some errors may occur because the local date rather than the GMT date may have been recorded at times. The event log for the depth recorder was kept initially in GMT, but because of confusion, local time was used from 10 August on. It was found much easier to reconstruct events and keep a running log of events if local time was used. In annotations, GMT was always suffixed with Z, local time usually suffixed with L.

To further confuse the issue, the ships were on differerent local times while operating together at T. ENDEAVOUR remained on the +7 zone throughout the cruise. The captain of DESTEIGUER wished to keep closer coordination with the sun so he kept local time with Stations S and C in the +7 time zone and A and T in the +8 zone. Despite this, no time zone errors occurred, since GMT was used for event and data reference. The system on ENDEAVOUR seems to be the least confusing and is recommended: keep one time zone throughout the cruise when the ship is returning to the same port.

I. POST-CRUISE OPERATIONS DEBRIEF WITH NAVOCEANO

In a meeting conducted by Richard Evans of NAVOCEANO operations on 12 September 1978, several problem areas requiring correction were discussed: pre-cruise communications, including technical specifications, AGOR cruise card, and major equipment list status; lab layout; 110v power monitoring; SatNav failure; SVSTD computer failure; XBT on-station restrictions; lack of aft bridge usage; and communications between ships. NAVOCEANO responses are given in Reference (5).

J. NEXT-OF-KIN-LIST

The Senior NORDA Scientist should consider obtaining the next-of-kin list of all the scientific party, including their home telephone numbers, before departing Bay St. Louis. This may be of great help in case there is a need to contact a person in the evening or on a weekend before he/she travels to the ship. The same list is required by the captain prior to sailing. This list should also be with one or two home-based persons who could be reached at any time after work hours. This information would be treated with the privacy desired by each person, but could be valuable for the operation.

K. NAME OF THE OPERATION - OUTPOST GUMBO

During the joint meeting with representatives from NADC, DREP, and NORDA on 6 March 1978, the need for a project name was established. The name, conceived in NORDA Code 340 and agreed upon by the other participants, was approved by J.B. Hersey on 19 May in conjunction with J.A. Blackenship at ONR 713. The name of the project was officially assigned for this operation by OP 952 on or about 6 June 1978. The first word, OUTPOST, is assigned to all oceanographic cruises. The second word must be nondescript. The name was assigned in accordance with OPNAVINST 5511.37 of 29 Mar 1967.

In retrospect, the name, although nondescript, has significance. "Outpost" reflects a group of Navy employees stationed remote from the base; "gumbo" represents the mud which influences bottom interaction and was sampled at Stations C, A, and T, and also encountered by the bottom of VEKA at Station S, in addition to being symbolic of the region where NORDA's roots are. The implication of a well-seasoned mixture cannot be overlooked either.

## VIII. REFERENCES


(1) Technical Specifications for Cruise 1208-78 aboard USNS DESTEIGUER, Aug 78, OUTPOST GUMBO, 18 Jul 78.

(2) Technical Specifications, OUTPOST GUMBO, Draft, 2 Jun 78.

(3) Field Assignment Memorandum, 344:RSA:mdc, 340/245-78, 21 Jul 78.

(4) Field Assignment Memorandum, 344:RSA:mbf, 340/322-78, 26 Sep 78.

(5) Memorandum for the Record, NAVOCEANO Code 3105:dgh, 20 Sep 78.

TABLE 1

OUTPOST GUMBO STATIONS

Position is location of DESTEIGUER during Bottom Interaction experiments at Stations C, A, and T, and during the CW projector tow at S. The time listed is when position was determined shortly before commencement of the experiments.

| STATION | TIME | DEPTH (Uncor. fm) (Cor. m) | POSITION |
|---|---|---|---|
| "S" Shallow<br>9-12 August | 1430L/10<br>2130Z/10 | 1215 fm<br>2252 m | 47°45'N<br>126°38'W |
| "C" Cascadian Plain<br>13-15 August | 1730L/13<br>0030Z/14 | 1500 fm<br>2786 m | 45°30'N<br>128°28'W |
| "A" Abyssal Hills<br>16-18 August | 1900L/17<br>0300Z/18 | 2117 fm<br>3953 m | 42°31'N<br>134°51'W |
| "T" Tufts Abyssal Plain<br>20-24 August | 1810L/20<br>0210Z/21 | 2335 fm<br>4370 m | 46°34'N<br>140°39'W |

TABLE 2

OUTPOST GUMBO EXPERIMENTS ON DESTEIGUER

| STATION | VEKA IA | VEKA II-22 | OTHER |
| --- | --- | --- | --- |
| S | Shallow deployment - test | Ambient Noise: 10 hours digital tape | XBT |
| | | Projector tow: 300 ft 33 nm<br>60 ft 33 nm | Survey: bathymetry (45 nm) |
| | | 15 hours Analog and Digital tape | SVSTD |
| C | Bottom Interaction:<br>1 run 244 m SUS<br>1 run 610 m and 1220 m SUS | | SVSTD<br>Survey: sparker (45 nm) |
| A | Long Range Propagation:<br>10 to 540 nmi<br>Ambient Noise:<br>10 hrs digital tape | | Core: 8 feet |
| | Bottom Interaction: | | Survey: sparker; close grid to determine roughness (185 nm) |
| | Rough area: 1 run 244 m SUS<br>1 run 610 m and 1220 m SUS | | |
| | Moderate area: 1 run 244 m | | |
| T | Bottom Interaction:<br>2 runs: 244 m SUS<br>1 run: 18, 183, 610 and 1220 m SUS<br>Ambient Noise: 9 hrs digital tape | Projector tow: 60 ft 35 nm<br>300 ft 60 nm<br>19 hours Analog and Digital tape | SVSTD<br>Core: scrapings only<br>Survey: sparker (80 nm) |

TABLE 3

BOTTOM INTERACTION DATA

OUTPOST GUMBO

| STATION | PURPOSE | NO. SHOTS | SHOT DEPTH (all 0.8 kgm) | SPACING |
|---|---|---|---|---|
| "C" Cascadian Plain 2780 m | Coherence, Multipath analysis | 53 | 224 m | 0.5 nm |
| | | 15 | 610 m | 1.0 nm |
| | | 5 | 1220 m | 1.0 nm |
| "A" Abyssal Hills 3900 m | Coherence | 84 | 224 m | 0.5 nm |
| | | 15 | 610 m | 1.0 nm |
| | | 5 | 1220 m | 1.0 nm |
| "T" Tufts Abyssal Plain 4400 m | Coherence, Multipath analysis | 96 | 244 m | 0.5 nm |
| | | 21 | 610 m | 1.0 nm |
| | | 5 | 1220 m | 1.0 nm |
| | | 29 | 183 m | 1.0 nm |
| | | 29 | 18 m | 1.0 nm |

VEKA I-A - vertical

10 elements analog
25 elements digital

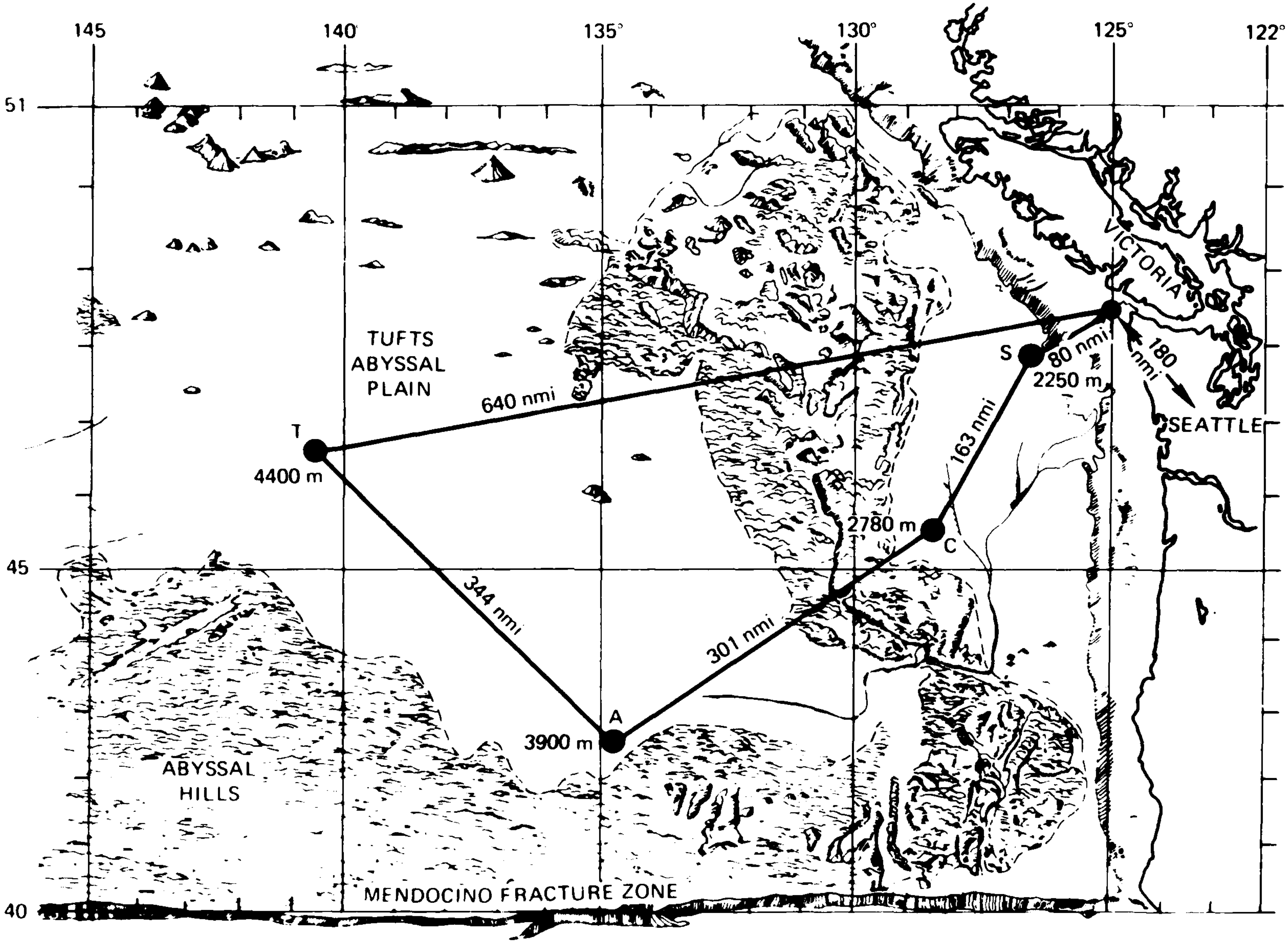


Figure 1. Track of DESTEIGUER for OUTPOST GUMBO

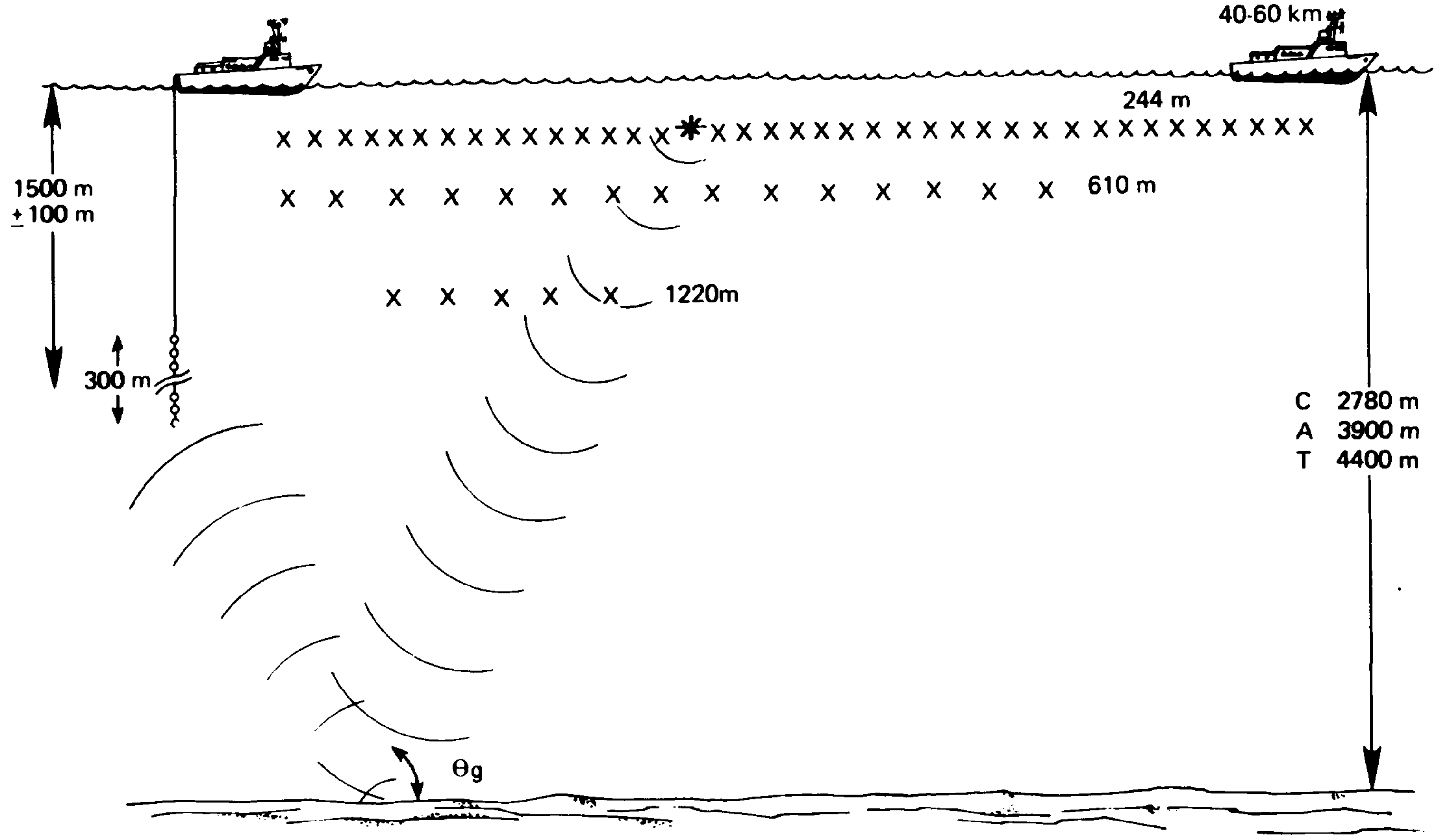


Figure 2. Bottom interaction geometry for OUTPOST GUMBO

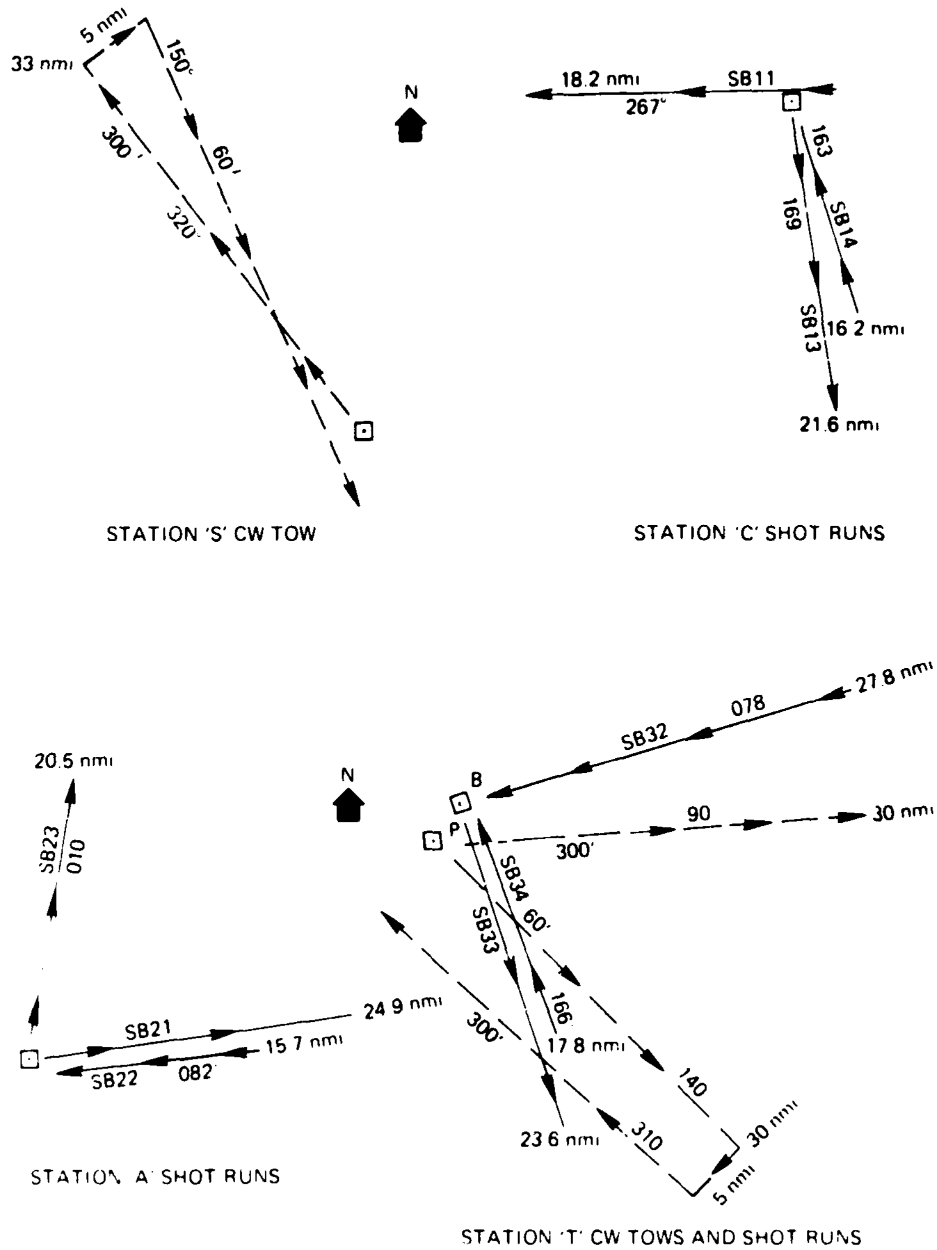


Figure 3. Tracks of CFAV ST. ANTHONY during the bottom interaction runs (SB-11-SB34) and CW projector tows. Positions of DESTEIGUER indicated by the square area listed in Table 1. At Station T, DESTEIGUER changed positions between experiments; position B is given in Table 1.

## DISTRIBUTION LIST

Chief of Naval Operations
Department of the Navy
Washington, DC 20350

| | | |
|---|---|---|
| ATTN: | Code OP-955FI (CDR R. D. Kelley) | (1) |

Commander, Third Fleet
Pearl Harbor, HI 96860

| | | |
|---|---|---|
| ATTN: | CDR A. Brooks | (1) |

Commander
Naval Air Development Center
Warminster, PA 18974

| | | |
|---|---|---|
| ATTN: | Code 3032 (Dr. B. Steinberg) | (3) |

Commander
Naval Electronic Systems Command
Department of the Navy
Washington, DC 20360

| | | |
|---|---|---|
| ATTN: | PME-124-34 (Mr. J. Reeves) | (1) |

Defence Research Establishment Pacific
Forces Mail Office
Victoria, BC, Canada VOS1BO

| | | |
|---|---|---|
| ATTN: | Dr. J. T. Flynn | (1) |
| | Dr. R. Chapman | (1) |
| | Mr. J. Thorleifson | (1) |

Commanding Officer
Naval Ocean Research and Development Activity
NSTL Station, MS 39529

| | | |
|---|---|---|
| ATTN: | Code 100 | (1) |
| | Code 110 | (1) |
| | Code 300 | (1) |
| | Code 301 | (1) |
| | Code 340 | (15) |
| | Code 350 | (3) |
| | Code 360 | (2) |
| | Code 500 (Mr. G. Lewis) | (1) |

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

| REPORT DOCUMENTATION PAGE | | READ INSTRUCTIONS BEFORE COMPLETING FORM |
|---|---|---|
| 1. REPORT NUMBER<br>NORDA Technical Note 48 | 2. GOVT ACCESSION NO. | 3. RECIPIENT'S CATALOG NUMBER |
| 4. TITLE (and Subtitle)<br>Cruise Report for USNS DESTEIGUER Operations in OUTPOST GUMBO | | 5. TYPE OF REPORT & PERIOD COVERED<br>Final<br>8-30 August 1978 |
| | | 6. PERFORMING ORG. REPORT NUMBER |
| 7. AUTHOR(s)<br>Rockne S. Anderson | | 8. CONTRACT OR GRANT NUMBER(s) |
| 9. PERFORMING ORGANIZATION NAME AND ADDRESS<br>Naval Ocean Research and Development Activity<br>NSTL Station, Mississippi 39529 | | 10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS |
| 11. CONTROLLING OFFICE NAME AND ADDRESS<br>Naval Ocean Research and Development Activity<br>NSTL Station, Mississippi 39529 | | 12. REPORT DATE<br>June 1979 |
| | | 13. NUMBER OF PAGES<br>27 |
| 14. MONITORING AGENCY NAME & ADDRESS(if different from Controlling Office) | | 15. SECURITY CLASS. (of this report)<br>Unclassified |
| | | 15a. DECLASSIFICATION DOWNGRADING SCHEDULE |

16. DISTRIBUTION STATEMENT (of this Report)

Unlimited

**DISTRIBUTION STATEMENT A**
Approved for public release;
Distribution Unlimited

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

18. SUPPLEMENTARY NOTES

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Underwater acoustic research, bottom interaction, signal excess, ambient noise, cores.

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

OUTPOST GUMBO was an underwater acoustic research operation at four sites in the northeastern Pacific conducted in August 1978. Participants included members from the Naval Ocean Research and Development Activity (NORDA), Defence Research Establishment (DREP), and the Naval Air Development Center (NADC). Platforms used were USNS DESTEIGUER, CFAV ENDEAVOUR, CFAV ST. ANTHONY, and two CFVP-407 ARGUS aircraft. Data were collected for acoustic bottom interaction, signal excess, and ambient noise, as well as environmental geologic and oceanographic data. Arrays over

DD FORM 1 JAN 73 1473 EDITION OF 1 NOV 65 IS OBSOLETE
S/N 0102-LF-014-6601

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered) were used as receivers: VEKA (NORDA), TSVLA (NADC), and MEVA (DREP). This report discusses operations, quantity and quality of collected data, and associated problems as related to NORDA's participation on board USNS DESTEIGUER.